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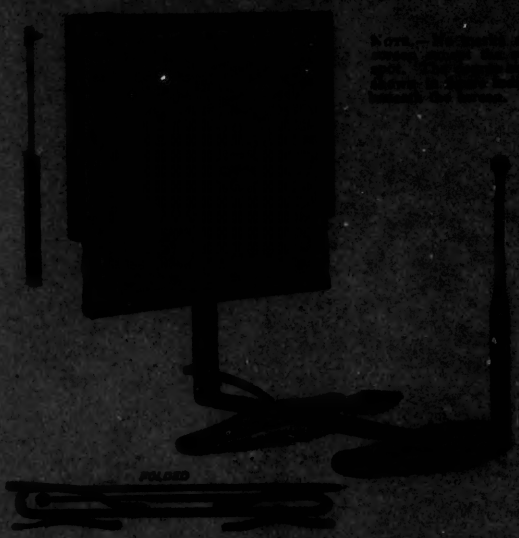

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OF

OPHTHALMOLOGY

NOVEMBER, 1922

COMMUNICATIONS

ACCOMMODATION AND OTHER OPTICAL PROPERTIES OF THE EYE OF THE CAT

BY

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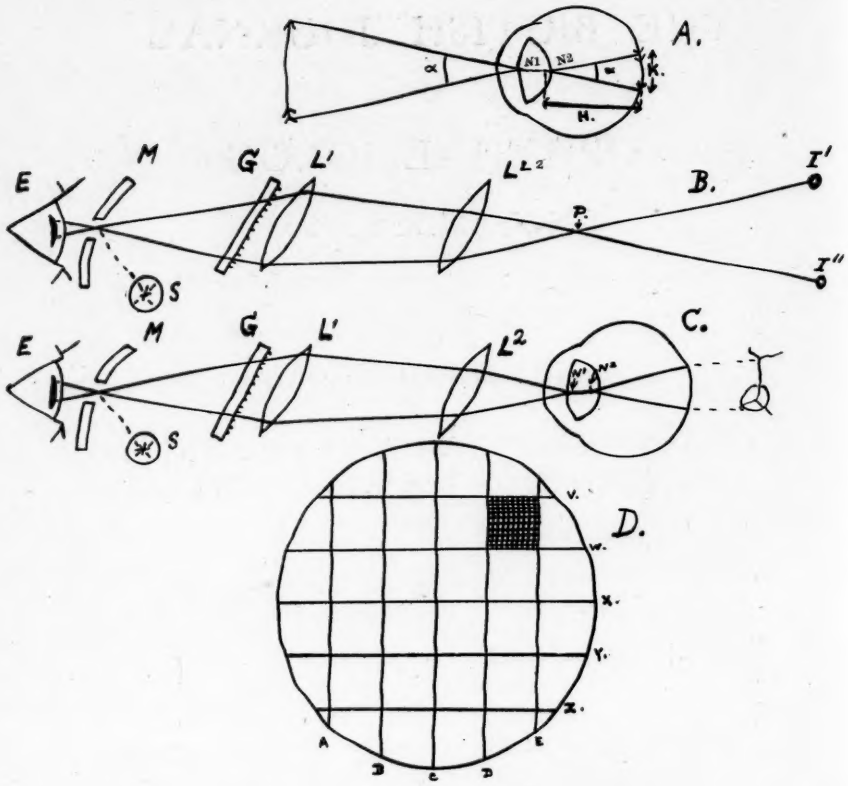
SECTION I.

A direct method of determining the refracting power of the whole eye

WHEREAS previously the power of the eye as a whole has been determined by adding together the separately ascertained powers of the corneae system and the crystalline system, we have endeavoured to obtain a direct method for ascertaining the power of the eye as a whole that would be applicable to animals, and in certain special cases to man himself. It should be pointed out that the disadvantage of the previous methods has been that the power of the crystalline lens had to be ascertained by observations made on the position of the refracted images as seen through the refracting surface of the cornea.[1] So that, for example, the position and therefore the curvature of the posterior surface of the lens would be affected by any errors already made in the measurements previously obtained for the anterior and posterior



A Illustrates basis of method of measuring focal length of whole eye. If K is ascertained by experiment H is readily calculated.

B Illustrates method of calibrating scale of instrument, E—eye of observer, S—light source, M—mirror, G—scale, L^1 and L^2—lenses, P—anterior principle point, I^1 and I^2 are movable indices. The angles which the indices make at the point P are recorded against the scale reading.

C Illustrates method of determining angle subtended by two retinal points, e.g., the bifurcation of a retinal vessel and the edge of the optic disc at the posterior nodal point of the observed eye by means of the instrument.

D Illustrates appearance of the scale. The letters correspond to those in Table I. All the squares were subdivided into 100 parts as shown in top right-hand corner.

surface of the cornea, the anterior surface of the lens and the depth of the anterior chamber.(2) Therefore the calculated power of the eye as a whole has been subject to error since the refracting powers of the separate parts from which it has been calculated have themselves been subject to ambiguity.

We have measured the power of the cat's eye directly by making use of the following physical relationship between the size of the object and the size of the image formed by a lens system.

In Diagram 1A is represented a complex lens system of which N^1 N^2 are the nodal points. Rays from two distant objects make with one another the angle a at the anterior nodal point N. Then the focussed images of those two distant objects on the screen also make the angle a with the posterior nodal point N^1. If R is a screen placed at such a position that the lens system forms sharply focussed images of distant objects on to it, then if the value of the angle a is known and the distance between the images "k" is known, the distance between the posterior nodal point and the screen R is readily ascertained since it equals $2k \times \sin \frac{1}{2}a$. The instrument that we have made use of is the orthoscope supplied by Messrs. Watson and Sons, and we have made this into an instrument capable of measuring the angle by placing a ruled glass micrometer screen just in front of the field lens L^1, as shown in Diagram 1B.

In this diagram is also shown the course of rays through the instrument to the eye. The calibration of the ruled glass screen in angular measure had to be performed by placing at a suitable distance from the instrument two indices I^1 and I^{11}. The angles subtended by the indices at the instrument were now ascertained by measuring the distances of the indices from one another and their mean distance from the anterior focal plane of the instrument. Preliminary observations showed that there was a gradual change in the angles representing ten fine scale divisions of the ruled glass screen, as one passed in a vertical or a horizontal direction. This was due to the considerable amount of coma introduced by the inclination of the lenses L^1 and L^2 to the optical axis. This inclination cannot be avoided, because it has to be introduced to eliminate the reflection that would normally take place at these lens surfaces as the beam of light from the source S passed by reflection at the mirror M along the optical axis of the instrument. The indices were therefore moved a step at a time, so as to correspond with the separate coarse divisions of the ruled screen marked A, B, C, D, E, and V, W, X, Y, Z, as shown in Diagram 1D, and in this way the angular values shown in Table I for the different divisions were obtained.

TABLE I.

	Distance between indices at 100 cms.			Distance from instrument
	Obs. H.	Obs. Y.	Mean	Angle
A B =	10·04	9·68	9·86	5·61
B C =	8·55	8·60	8·58	4·91
C D =	7·85	7·70	7·78	4·45
D E =	7·25	7·25	7·25	4·17
V W =	—	—	8·85	5·08
W X =	—	—	8·00	4·60
X Y =	—	—	8·42	4·84
Y Z =	—	—	8·42	4·84

The first factor of importance that came up for determination was the effect of the distance between the orthoscope and the lens system under measurement (e.g., an eye) on the power of that lens system as given by the instrument. The result of one such test is shown in Table II.

TABLE II.

Effect of distance between instrument and lens system under measurement:—

Distance in mm. between instrument and lens system under measurement.	Focal length of lens system in mm. as given by instrument.
36 mm.	16·5 mm.
96 mm.	16·12 mm.
Difference 60	0·38
,, 63 per cent.	2 per cent.

It will be seen that a considerable change in the distance (namely, 60 mm.) resulted in an error in the focal length measurements given by the instrument of less than 2 per cent. Therefore, if care were taken to preserve the distance between the instrument and the lens system at roughly 66 mm. (the place at which the anterior focal distance of the instrument was found to be situated), errors due to small variations in the distance between eye and instrument could be altogether neglected.

Method of using the instrument

The actual process of making measurements with the instrument described above will now be given in detail, because a number of points in the technique came up for consideration in the initial stages of the research, and accuracy was only obtained as the result of experience. The animal under investigation was invariably anaesthetized. In the case of the cat, either lighter anaesthesia with chloroform or rather deeper anaesthesia with urethane

was generally found necessary. The animal was placed comfortably inside a wooden box, cotton wool, straw and other packing being placed round it so as to prevent undue movement. Through the lid of this box the animal's head protruded, and it was held by the hand of an assistant, who turned the head gently so that the eyes faced in different directions as required by the observer at the eyepiece of the instrument. In a few cases only was it found necessary to apply any surgical instrument to the eye under observation. It was found, for example, in the case of one cat that when the anaesthesia was profound the nictating membrane tended to rise and obstruct the passage of light through the cornea. In these cases the ordinary spring speculum employed in ophthalmic practice was applied. The beam of light from the instrument was now directed into the eye under observation and the position of the images of the retinal vessels, blind spot, etc., as seen from the instrument noted. A considerable amount of time was usually required to get a suitable part of the retina under observation in the field of the instrument. As a rule the angular measurements were made from one edge of the blind spot to the bifurcation of one of the retinal vessels, a drawing being made of the appearance seen through the instrument as the view of the retina was projected on the ruled glass screen. The number of scale divisions, both vertical and horizontal, which corresponded to the distance between the blind spot and the bifurcation of the vessel was also noted on the drawing. The anaesthesia was now pushed to greater and greater depths until it resulted in the death of the animal. After that the eyeball was very carefully removed, its position in the head having been marked by passing a thin black ligature (e.g., sewing silk) through the sclera just beyond the corneo-scleral junction. The eyeball was now divided into two halves and the retinal half placed on a glass slide, the black thread remaining attached to one edge of it so that the proper position of the retina as it lay originally in the animal's head could be preserved. A micrometer microscope was now used for measuring the actual distance in millimetres between the edge of the blind spot and the bifurcation of the vessel which had been made the subject of measurement by means of the orthoscope. Reference had, as a rule, to be made to the drawing of the retinal vessels previously described, in order that there should be no possibility of mistake resulting in the measurement of a different blood vessel. From these two determinations, namely, the measurement of the angle ($=a$) subtended by this portion of the retina as seen from the orthoscope and the actual distance ($=d$) between the same structures as measured by the microscope micrometer, the focal length ($=$L) of the lens system of the eye can be ascertained, since L is equal to $d/2 \sin a/2$. The accuracy of this

method was ascertained by making some preliminary measurements on a glass lens system of known focal length. A glass lens of 55 mm. focal length was mounted in a hole in the side of a light-tight box, a cardboard screen being placed at a distance from the lens equal to its focal length. On this were mounted indices of black paper, the edges of which were placed 12 mm. apart. These were found to measure 21.8 scale divisions as observed through the orthoscope. The angle was found by reference to Table I to equal 12.3°. From these two values the power of the lens was found to be 56 mm., so that the difference between the true power and the measured power was 1 mm. Some values obtained by this method of measurement on the eyes of three cats are given in Table III.

TABLE III.

Measurements of focal lengths and power in dioptres of cat's eye :—

Number of cat	1	2	
Right or left eye	Rt.	Lt.	Rt.
Distance between images in mm. (= *d*)	3·44	4·00	1·7
Angle between images (= *a*)	11·86	16·2	6·7
Sine ½ angle *a*	0·10337	0·1407	0·0584
Focal lengths	16·6 mm.	14·2	14·5
Power in dioptres	60·5	70·4	68·8
		Difference	1·6 D.

Number of cat	3	
Right or left eye	Lt.	Rt.
Distance between indices	3·77	3·26
Angle between images (= *a*)	12·65	11·38
Sine ½ angle *a*	0·1102	0·0976
Focal lengths	17·0	16·7
Power in dioptres	58·9	59·8
	Difference	·9 D

It will be observed that the power in dioptres of the whole eye varies between 58.9 and 70.4, but in the case of the latter figure (which was one of the measurements obtained on Cat No. 2), the value may be rather above the normal, because this animal was not fully grown. Since growth would tend to increase the size of the eyeball it would therefore tend to make the apparent power in dioptres decrease. It will be seen further that the values obtained for the right and left eyes correspond well with one

another. In one case the difference was found to be 1.6 dioptre, and in the other case 0.9 dioptre. These values appear to us to show that a considerable degree of accuracy may be obtained by the use of this direct method of measuring the power of the eye, and this method can be applied in certain circumstances to the eye of man.

SECTION II.

Determination of the separate refracting powers of the cornea and crystalline lens

The radius of the cornea was measured, previous to the examination of the eye by the orthoscope as described above, by means of the instrument known as the " new " keratometer.[7] In this instrument the two images of a suitable mire (one seen directly and one seen through a prism) are caused to come into coincidence by changing the position of the prism, and this instrument, when suitably calibrated, gives a direct measurement of the refracting power of the cornea. With this instrument the corneae of the cats under light anaesthesia were measured and the values are given in Table IV.

The power of the crystalline lens was obtained by removing the lens from the anterior half of the eyeball (which had been placed on one side after the removal of the retina for the purpose of the measurements described in Section I). The lens was placed in some mammalian Ringer's fluid in a small glass vessel with plane parallel glass sides. The trough containing the crystalline lens was placed on the stage of a micrometer microscope so that the centre of the crystalline corresponded with the optical axis of the instrument. A ruled glass micrometer was then attached to a ring placed in the plane of the mirror; the image of this ruled glass micrometer as formed by the crystalline lens was examined by the micrometer microscope.[6] The values obtained are given in Table IV.

TABLE IV.

Powers given in dioptres:—

No. of cat... ...	1	2		3	
Right or Left ...		Rt.	Lt.	Rt.	Lt.
Cornea	37·1	42·2	41·75	39·1	38·75
Lens actual ...	46·1	55·3	—	46·9	—
Correction ...	10·53	12·6	—	10·95	—
Lens effective ...	35·57	42·65	—	35·95	—
Lens plus cornea...	72·67	84·65	84·40	75·0	74·7

It will be observed that the lenses in the case of Cats Nos. 1 and 3 were between 46 and 47 dioptres, that of Cat No. 2, i.e., the one which had a small eyeball, of rather higher power than the others, having a focal length of 55.3 dioptres.

From these two determinations (i.e., that of the power of the cornea and that of the power of the lens) the power of the eye as a whole can be ascertained by means of the use of Formula 16, *Gleichen's Modern Optical Instruments,* p. 42. One of the data required for the use of this formula is that of the depth of the anterior chamber of the eye. This was measured on one of the intact eyeballs of Cat No. 3 after death by means of a depth-measuring micrometer microscope. A small metal rod was passed through the cornea close to the corneo-scleral junction so that its point rested on the anterior surface of the lens. The apparent distance between the upper surface of the cornea and the anterior surface of the lens was now measured by first focussing one and then the other and ascertaining the movement in millimetres that had been necessary in order to do this. The following values were obtained, 4.35, 4.15, 4.45, 4.4 and 4.4, giving a mean of 4.35 mm. From this value the real distance between the surface of cornea and anterior surface of lens was ascertained by inserting suitable values into the formula :—

$$f^1 = \frac{F^1 f^2}{f^2 - F^2}$$

$F^1 = 25.7$, $F^2 = 34.3$, and therefore $f^1 = 3.74$ mm. The actual power of the crystalline lens in dioptres must therefore be reduced by 3.74 × refraction of the cornea in dioptres × refraction of the crystalline lens in dioptres. The values obtained for this correction that must be applied to the lens, for the whole eye, for the cornea, for the actual lens, and for the cornea plus the corrected lens are given in Table IV.

SECTION III.

Consideration of the validity of Tscherning's criticism of Helmholtz's theory of accommodation

Tscherning has stated[3] that measurements made on the crystalline lens of man, when removed from the eyeball, show that the lens is not in its fully accommodated condition as Helmholtz's theory leads one to suppose that it should be. And he states that Helmholtz's own figures demonstrate this lack of agreement. For this reason Tscherning himself advances an alternative theory of the method in which the accommodation of the eye takes place.[8] The values that we had obtained are summarized in Table V. So far as we have been able to discover, no experiments have

ever been done on animals except perhaps the needle experiment of Henson and Voelckers[9] which would tend to decide between these rival theories. We thought that it would be of interest therefore to apply the facts that we have obtained from the measurements described in the previous two sections to the elucidation of this problem.

TABLE V.

Values in dioptres:—

Lens plus cornea...	72·67	84·65	84·4	75·0	74·7
Whole eye ...	60·5	70·4	68·8	58·9	59·8
Difference ...	12·2	14·2	15·6	16·1	14·9
Mean difference ...	14·6				

It will be observed that the combined power of the lens and cornea exceeds that of the whole eye by a figure which varies between 12.2 and 16.1 dioptres. In other words, the lens plus cornea has a greater refracting power when the two measurements are made separately (the crystalline lens having no traction on it due to its suspensory ligaments) than that given by the whole eye when presumably the suspensory ligaments are in a state of traction, thus flattening the crystalline lens. We conclude, therefore, that the crystalline lens of the cat when the eye is not in an accommodated state is flattened by the pull of the ligaments to an extent that decreases its curves so as to diminish its power by approximately 14 dioptres, and this is entirely in favour of Helmholtz's hypothesis, and is equally at variance with that of Tscherning.

There seems to us to be little doubt, therefore, that in the cat, at all events, accommodation takes place in the manner that Helmholtz suggested, and when this conclusion is taken in conjunction with the findings of Grossmann[10] and Hess[11] in the case of man, there would appear to be insuperable evidence against Tscherning's criticism. Grossmann found in the case of a man of 26 years with congenital absence of the iris that:—

1. The accommodated lens became 1.25 mm. smaller in diameter.

2. That it became 1.3 mm. thicker.

3. That the lens became tremulous owing to slackening of the suspensory ligaments, as Hess had described.

4. He also found that the lens surfaces near the centre of the pupil became relatively more curved than the more peripheral parts; an anterior and posterior lenticonus was formed.

The first three observations are quite incompatible with Tscherning's teachings; the last one agrees in showing that accommodation does to some extent affect central more than peripheral parts of the lens, which would account for the images obtained by Thomas Young[12] with his optometer, confirmed by the experiments of Mannhardt[13] and Schoen[14]. Evidence is, on the other hand, altogether wanting that more than a relative flattening takes place, whereas the unaccommodated lens has an anterior surface which is nearly spherical and 10 mm. radius. Tscherning's theory requires that while its central part becomes more curved, changing, say, from 10 mm. radius to 6 mm. radius, its peripheral part becomes flatter, its radius increasing beyond 10.

For this there is no evidence. What there is evidence for is a decrease in the radius both of the central and peripheral parts on accommodation, but of the two the peripheral suffers the less change. There is therefore relative but not actual flattening.

We thought it would be of interest to ascertain how much of this potential accommodation of 14 dioptres the cat actually makes use of during life; we therefore obtained some measurements of the amplitude of accommodation of one of the cats referred to above. The refracting power of the eye when under the influence of atropin was measured by the ordinary mirror test that is used in ophthalmic practice, and this was repeated with the eye under eserin. We found, however, that the contraction of the pupil under eserin was so strong that there was no pupillary aperture through which observations could be made, and therefore in one of the other cats we performed a preliminary iridectomy operation under deep anaesthesia. Subsequent observations did not give a greater difference than 3.5 dioptres between the values found for the eye when under atropin and for the same eye when under eserin, and it is possible either that the adult cat only makes use of 3.5 dioptres of the potential accommodation of 14 dioptres (because, possibly its ciliary muscles are insufficiently strong to exert the necessary traction) or it is possible that the eserin had not been allowed to act for a sufficiently long time, or there is a third alternative that it has not the same powerful effect on the accommodation in the case of the cat that it has in the case of man. (In this connection it is interesting to note that of the potential accommodation of about 10 dioptres possessed by a man of 26 years of age Grossmann was only able to find 5 using eserin and atropin.) We should mention at this point that we have found all three cats used for the purpose of these determinations to be almost emmetropic, which is at variance with the usual statement that the cat is short-sighted.

SECTION IV.

Light transmitting power and resolving power

The above measurements would hardly be complete without some attempt to ascertain in what way the cat's eye differs from man's eye as an instrument for receiving light from external objects and of forming sharply focussed images of these objects on the retina. We found that the maximum diameter of the pupil which the cat's eye gave when under the influence of atropin was very nearly 15 mm. Now our figures for the focal length of the intact adult cat's eye are approximately 14.3 mm.; the aperture ratio, that is the apparent pupil diameter, divided by the focal length has a value of approximately 0.97. In the case of man the maximum pupil diameter under atropin is approximately 10 mm., and the focal length as calculated by Helmholtz is approximately 15 mm., which gives the aperture ratio of 1.5. Now the efficiency of the eye as a light gathering organ varies as the square of the aperture ratio, and therefore the relative efficiences of man's eye and the cat's eye are as 1.5^2 is to 0.97^2, and this is found to give a value for the relative efficiency of 2.4, that is when the pupils in both cases are at their fullest dilation, or are at the same relative dilation. The luminosity of the images formed on the retina will therefore, in given circumstances, be 2.4 times as bright in the case of the cat as in the case of man.

We have now to consider the relative resolving powers. If both eyes were entirely free from aberration the focal lengths being so nearly alike, say, 14 mm. for the cat and 15 mm. for man, there would be no very obvious difference in the scale of retinal images that could be resolved in the two cases, assuming that the distance between the foveal cones are the same in cat and in man. But it is well known that spherical and chromatic aberrations form important factors in the case of the eye of man, and that considerable modification takes place in the images formed on the retina as the result of the phenomenon of diffraction. Now we have observed during these investigations considerable amounts of aberration in the cat's eye. Not only is the normal cornea of the cat apparently irregular in its surface, but also there is considerable change in curvature as one makes one's measurements away from the centre or at the centre. Further, when making measurements on the crystalline lens it was found almost essential to employ a colour-filter transmitting green rays because of the obvious chromatic difference of magnification and chromatic difference of focus that was manifest in the image. It would seem, therefore, that any gain from diminished diffraction which the cat might obtain owing to the large aperture ratio that it appears to employ is more than spoiled by the considerable aberrations

which are thus introduced at the same time. So that we would conclude that the ability to collect a large amount of light and therefore to form bright images on the retina is done at the expense of resolving power.

Summary

A method of determining the focal length of the eye as a whole in situ is described. It depends on the determination :—

(*a*) of the angle subtended by the images of chosen retinal structures at the anterior nodal point of the eye, and

(*b*) the actual distance between those same structures.

The values thus obtained for the right and left eyes of two cats were concordant to within 2.5 per cent., and the powers of the eyes were found to average between 60 and 70 dioptres. The powers of the corneas and crystalline lenses after removal from the eyeballs were also determined and were found to average 40 dioptres and 50 respectively.

From these values and those of the depths of the anterior chamber the average power of the fully accommodated eye was calculated to be about 80 dioptres, that is, roughly, 15 dioptres more than the direct values for the unaccommodated eye in situ. This kind of difference in value is in agreement with Helmholtz's theory of the accommodation of the eye, and is at variance with that of Tscherning. Other points with regard to the rival theories of accommodation and to the eye of the cat as an optical instrument are discussed.

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OCULAR SARCOMA WITH WIDE EXTENSION, INVOLVING BRAIN AND SPINAL CORD*

BY

HUMPHREY NEAME

LONDON

IT is rare for penetration of the globe to take place in cases of epibulbar sarcoma. Still more rare is it for this to occur without extensive damage to the form of the eyeball. The present paper is an account of a case in which this occurred, and a review of the literature which bears on the subject.

In May, 1919, a man named F. B., aged 53 years, felt, according to his statements, slight irritation beneath the upper lid of the left eye. He noticed this first while riding a cycle, and on the same day he found that there was a small swelling beneath the lid, on the eye just above the " coloured part " of the eye. The swelling was about the size of a split pea when he first noticed it. He did not feel any change in the sight of the left eye until December, 1919, although the lump increased steadily in size.

In July, 1919, B. attended the Royal London Ophthalmic Hospital under the care of Sir John Herbert Parsons. At this date, examination carried out at the hospital revealed, according to the notes, that the vision was as follows:—R. eye, 6/36, c. $-2.5=6/5$. L. eye, 5/60, c. $-3.5=6/6$. There was noted then " solid oedema " round the cornea, especially above.

A history was obtained from B. of ulceration of the palate followed by perforation, and falling in of the nose to some extent. The Wassermann reaction was carried out by Dr. S. H. Browning, and was found to be positive, on October 15, 1919.

Internal administration of mercuric chloride was adopted, and in November and December, 1919, and January, 1920, intravenous injections of novarsenobillon were given, with a dosage of from 0.3 up to 0.9 gram, which totalled 4.05 grams.

In January the iris was greenish, the pupil irregular, and the condition of oedema around the cornea was unchanged. There were also vitreous opacities.

In July, 1920, the notes reveal that the oedema was as before, that there was much " K.P.," and that a small brown-red mass was visible in the lower part of the anterior chamber in front of the iris. In September the tension of the left eye was referred to as T.+1.

In March, 1921, at Sir John Herbert Parsons's invitation, B. was seen by the writer. B. stated then that the sight of the left eye began to fail in December, 1919. In March, 1921, there was merely perception of light with the left eye. There was then

* Case described at a meeting of the Ophthalmic Section of the Royal Society of Medicine in the first quarter of 1922.

marked swelling of the sub-conjunctival tissue and overlapping of the conjunctiva over the corneal margin all round (Fig. 1). This gave an appearance of proptosis, but careful measurements taken showed the plane of the cornea, on the right as on the left, to be 8 centimetres anterior to the mandibular condyle. The conjunctiva covering the swelling was tense, smooth, glistening, and adherent to the swelling. It was also diffusely reddened, and showed several vessels coursing over the swelling towards the cornea. The swelling was firm throughout its extent.

The cornea, encroached upon as described, was markedly hazy throughout, and this appeared to be superficial and deep. No

FIG. 1.
Photograph of the eye before enucleation.
Shows the prominence of the tumour particularly above the cornea.

vessels were seen in its substance or on its surface. There was a small brown-red patch dimly visible in the lower part of the anterior chamber, which was taken to be a hyphaema.

No details were visible of iris or lens, and there was no red reflex. Vision of the left eye was perception of light.

The globe was excised on March 24, 1921, and placed in 4 per cent. formaldehyde.

Collateral investigation

Fracture.—A fracture of the right tibia was sustained late in 1919. On the admission of B. to the Royal London Ophthalmic Hospital the fracture was found to be united so that the patient could walk with slight difficulty. In order to exclude the

possibility that the fracture was associated with a new growth of the bone of the nature of a plasmacytoma, enquiry was made of Mr. Charles Gibbs, under whose care the patient had been. The latter kindly reported that the fracture was "a long oblique fracture of the tibia, slightly spiral, united in good position. No suggestion of new growth at all; normal tibia otherwise. Fibula not fractured, is thickened opposite the fracture, and above and below it, with new periosteal bone, probably compensatory. September 27, 1921."

Blood.—In September, 1921, a blood examination carried out by Dr. S. H. Browning showed a normal white cell differential

FIG. 2.

Drawing of section of the eye. Sagittal plane.

(*a*) The growth overlapping the upper part of the cornea.
(*b*) The growth below the cornea.
(*c*) Track of growth connecting the epibulbar part with that in the Canal of Schlemm.

count. A further blood count carried out in December, 1921, revealed an excess of large hyaline cells only.

Polymorphonuclear	50	per cent.	
Small lymphocyte	10	,,	,,
Large lymphocyte	19	,,	,,
Eosinophile	2	,,	,,
Large hyaline	19	,,	,,
(110 counted)	100	,,	,,

Examination of excised eyeball

Macroscopic. Formalin fixation.—The eyeball was bisected vertically (Fig. 2). Externally the globe showed little more than

was visible clinically. The main swelling was present around the corneal margin, and particularly the upper part.

The cut surface revealed a homogeneous dense, firm, white mass surrounding and encroaching upon the cornea. The mass was covered anteriorly by smooth glistening conjunctiva, and in its cut surface was decidedly larger above the cornea—superiorly than inferiorly—and in the former situation measured 14 mm. antero-posteriorly, and up to 6 mm. in thickness.

The extent of *cornea* that was visible from in front measured 8 by 8 mm., was densely nebulous, and appeared slightly thicker

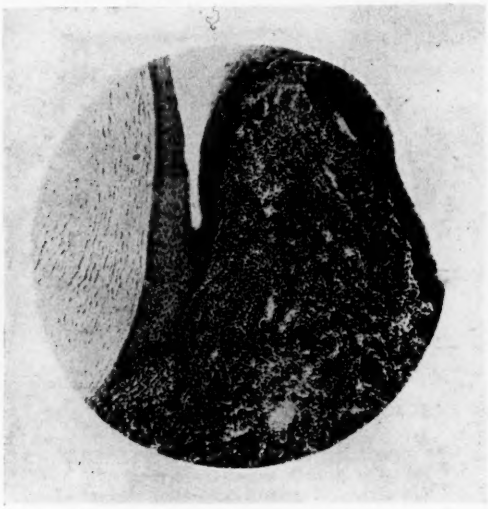

FIG. 3.

Microphotograph of the growth overlapping the lower part of the cornea. This corresponds with " b " in Fig. 2.

in section than normal. The *iris and ciliary body* were much thickened. The *anterior chamber* contained a small amount of flocculent material, and in the lower part a stratum of brown substance. The lens had a normal appearance. The retina was in situ. The *choroid* was much swollen, and at the posterior pole was almost as thick as the sclerotic on section. The *vitreous* cavity was occupied by pale greenish substance of firm elastic consistency.

Microscopic.—Half of the globe was embedded in celloidin. Sections were stained with Ehrlich's haematoxylin and eosin. In these sections the mass of tissue overlying the periphery of the

cornea is seen to have split the corneal epithelium into two layers for a short distance and to have derived its covering partly from the outer layer of this and partly from the conjunctiva. In some parts this covering epithelium is thickened and contains cells which have the appearance of prickle cells. (The general distribution of the new formation is seen in Fig. 2, and its relation to the cornea near the lower part of the limbus in Fig. 3.) The corneal epithelium, where it is overlapped by the mass, has its outer layers flattened and in places changed into much elongated cells. Bowman's membrane is intact, and a slight invasion of the substantia propria is seen to have occurred at the limbus and of the superficial layers of the sclera posterior to this. The substantia propria is elsewhere unaffected except for a slight increase of cellular elements near the centre of the deeper layers. Descemet's membrane is intact, and the endothelium is visible throughout except where it is obscured by a cellular deposit on its deep surface. The deposit is present as a thin layer of cells all over the greater part of the deep surface of the cornea. The cells are of a similar character to those forming the main mass, whose minute structure will be described later.

The *anterior chamber* is, in the sections, up to 3 mm. in depth, and contains in addition to the deep corneal deposits, a mass of cells projecting upwards from the inferior angle almost to the centre of the chamber, with some faintly eosinophilic hyaline material anterior and posterior to this cell mass. The angle of the chamber in its upper part also contains detached groups of cells, and others upon the ligamentum pectinatum iridis, which appear to be continuous with similar cells that infiltrate the ligamentum. Through the spaces in the ligamentum pectinatum the cells are seen to extend into the iris and ciliary body, and also into the area that should be occupied by the canal of Schlemm. No endothelial lining can be detected as representing this canal, so dense is the cell infiltration. The *iris and ciliary body* are both densely infiltrated throughout with similar cells, almost to the disappearance of normal structures. In the iris traces of the sphincter pupillae can be seen, and in the ciliary body fibres of the ciliary muscle can be detected. The pigment epithelium of the iris is intact, and the epithelium covering the ciliary processes and that of the pars ciliaris can be seen, although these latter are partly obscured by the cell infiltration within the ciliary body, and by layers of cells upon its surface. The lens structure is normal.

The remaining structures within the globe will be described later. The sclera and the continuity of the new cell formation without and within the eye will now be considered.

The sclera is almost entirely enclosed within a coat of closely-packed cells. This covering is continued backwards from the

masses of cells seen in the sections overlapping the superior and inferior parts of the cornea (Fig. 2). It is thickest where a vena vorticosa is sectioned near the equator and posteriorly around some posterior ciliary vessels. In both these regions there is a thick dense cellular mass surrounding the several vessels.

FIG. 4.

Microphotograph, magnification 30 times.

(*a*) Cornea.
(*b*) Root of iris densely infiltrated with growth.
(*c*) Ciliary body densely infiltrated with growth.
(*d*) Epibulbar growth over the lower part of the cornea.
(*e*) Growth cells on the posterior surface of the cornea.
(*f*) Track of growth connecting the epibulbar with the intra-ocular part of the growth. Corresponds with "c" in Fig. 2.

The optic nerve cut in transverse section immediately posterior to the globe shows an abundance of cells surrounding the posterior ciliary vessels and in the loose connective tissue outside the dural sheath. These cells show long spindle or rod shaped nuclei.

Wherever, if the sclera were normal, it would be expected to

show its various perforating vessels, there it encloses strands or masses of cells. From the site of the canal of Schlemm in front, outwards and backwards extend strands and masses of cells. (Fig. 4.) Similarly near the equator and near the posterior pole roadways crammed with cells can be traced in successive sections extending between the choroid and the exterior cell masses. Nowhere does there appear to be any wide breach of the defences such as occurs in the majority of specimens of penetrating epibular sarcoma that have been described. Rather there seems to have been a more sinister and less dramatic entry through almost every available portal.

Within the vitreous are small clusters of cells scattered about in its anterior part in the region of the pars ciliaris retinae and the anterior part of the retina.

The retina is in situ except for a small area in the inferior part of the globe, where the detachment took place in the course of fixation and dehydration of the specimen. It is everywhere normal apart from some delicate cystic degeneration most marked in the ganglion-cell and nerve-fibre layers. Nowhere is there any invasion or involvement of the retina by the new cell formation.

The choroid throughout is much thickened and intensely infiltrated with cells of similar appearance to those in other parts of the globe. The delicate structure of the choroid is entirely obliterated, and only the medium-sized and larger vessels are seen. As already mentioned, this cell infiltration can be traced in some of the sections along tracks through the sclera at the usual sites occupied by venae vorticosae and posterior ciliary vessels (Fig. 5).

The minute structure of the new formation.—The growth everywhere is composed of closely-packed masses of cells, freely supplied with delicate capillaries. With Zeiss D. objective and No. 4 eye-piece the nuclei are seen to be round or oval, or of slightly irregular outline. For the most part they are round. The cell protoplasm is not well differentiated. There are also a number of rod shaped or spindle-like nuclei which stain less darkly with haematoxylin. These elongated nuclei are twice or even three times the length of the average round nucleus. The cells are frequently found to be arranged in double rows of six or eight nuclei in each, with a narrow space between the two rows, which gives the appearance of tubule formation. In other places there are incomplete rings of cells as of tubules cut transversely, which simulate to a slight degree the rosettes of glioma of the retina. These pseudo-tubules have no endothelial lining. Some of the more delicate capillaries have at first sight a similar appearance, but they are distinguished by the definite lining of flat endothelial cells with the cells of the new formation arranged along the outer

surface of this lining. Examination with the 1/12 oil immersion objective reveals the presence of fairly frequent mitotic figures.

A small slice was cut off from the celloidin block, to include the smaller inferior portion of growth where it projected over the cornea, and the infiltrated iris. This was re-embedded by

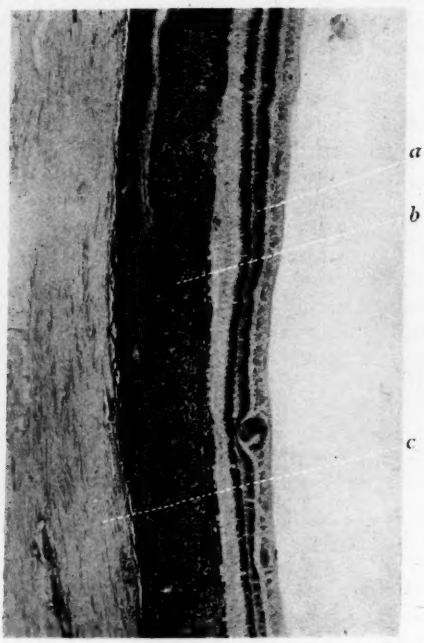

FIG. 5.

Microphotograph, magnification 30 times.

(*a*) Retina.
(*b*) Choroid densely infiltrated with growth.
(*c*) Sclera.

This represents part of the coats of the globe near the posterior pole.

Jordan's method, and thin sections were cut and stained by Weigert's iron haematoxylin and van Gieson's stain.

Van Gieson's stain shows a very limited amount of collagen fibre, and this chiefly in the immediate neighbourhood of the covering conjunctival epithelium, or at the outer surface of the sclera or limbus where the cells are seen to be infiltrating these tissues and breaking up, or spreading between their lamellae. It

seems probable that the bulk of this collagen fibre is derived from the infiltrated structures. In one part, near the surface of the extra-ocular portion a very marked proliferation of rod shaped and spindle-shaped cells is seen. Many of these nuclei are as long as from three to five times the diameter of an average circular nucleus. Many are curved. In this particular area red corpuscles are seen to occupy small capillaries which are particularly abundant, and corpuscles are also apparently lying among some of the cells of the new formation.

Further progress of the case.—On June 16, 1921, there was a swelling in the socket, beneath the well-healed conjunctiva (see stereo-photograph, Fig. 6). The conjunctiva was smooth and

FIG. 6.
Stereo-photograph of the socket with the lids drawn back, before the operation of exenteration of the orbit was performed. Shows the prominent mass which filled the orbit.

glistening, and contained an abundance of well-filled blood vessels, clearly shown in the photograph. The swelling was ovoid and about 2 cm. in horizontal diameter and 1.3 cm. vertically. It was firm, slightly elastic, and movable within the orbit to a moderate degree.

Apart from the swelling in the left orbit the patient complained of no symptoms. The abdomen was examined, but revealed to palpation no presence of any abnormal swelling, and to percussion no unusual area of dulness.

On July 6, 1921, the operation of exenteration of the orbit was carried out by Sir John Herbert Parsons. The orbit healed satisfactorily. The patient was seen by the writer in the middle of February, 1922, and appeared quite well, with no sign of orbital recurrence.

Pathological examination of the tissue removed from the orbit.—The mass was composed of the edges of the eyelids and a margin

of normal skin, the palpebral conjunctiva and that covering the mass, a quantity of fibro-fatty tissue and within the latter an egg-shaped mass of elastic consistency measuring 2.5 by 1.7 by 1.5 cms. On one surface this mass was covered by a smooth glistening membrane continuous with the palpebral conjunctiva, on the other side it was not clearly demarcated from the neighbouring tissues. There were a few subsidiary nodules in connection with the main mass. The cross-section of the mass showed an almost dead-white finely granular surface, with a few pale red-brown streaks and spots mainly near its periphery.

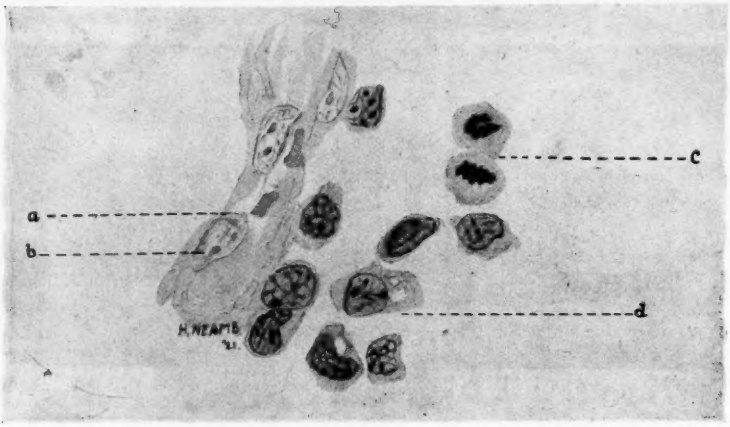

FIG. 7.

Drawing of a section of the orbital recurrence as seen with 1/12 oil immersion and No. 2 Zeiss E.P.

(*a*) Red corpuscle in a capillary.
(*b*) Endothelial cell of capillary wall.
(*c*) Growth cells undergoing karyomitosis.
(*d*) Growth cell with protoplasmic processes and vacuolation.

The whole specimen was placed for 24 hours in 4 per cent. formaldehyde, after which all but a small portion of the mass was transferred to Muller-formol solution, in several changes of which it was fixed for over six weeks. Sections of the portion fixed in formalin were unsatisfactory, as the tissue appeared to be incompletely fixed. Part of the mass fixed in Muller-formol was embedded in paraffin in the usual manner, and from this sections were prepared and stained with Ehrlich's haematoxylin and eosin, with Weigert's iron haematoxylin and van Gieson's picric acid fuchsin counterstain, and thirdly with Pappenheim's stain.

Microscopic examination.—Sections show that the mass is

composed of cells with large round, oval or kidney-shaped nuclei, and a fairly abundant cell protoplasm (Fig. 7). The nuclei contain one or two and often three large nucleoli and a rather openwork chromatin pattern of coarse threads. The individual cells are, many of them, round and free, some show protoplasmic processes, and some, where packed closer together, show a polygonal form. Here and there vacuoles are present in the protoplasm. The tissue is evidently in a state of active proliferation, for mitotic figures and cells with double nuclei are not uncommon. Pappenheim's stain reveals no plasma cells. Delicate blood capillaries are seen throughout the section and very sparsely scattered collagen-fibre supporting tissue. The latter is more obvious in the periphery of the mass, presumably where the cells are in process of invasion of the orbital tissues. There is no definite pattern or arrangement of the cells in the recurrent mass as in the original growth. (The drawing represents the appearance of a few of the cells alongside of a capillary.) Section of the posterior end of the optic nerve shows degeneration of the nerve bundles, and an increase of fibrous tissue between these. Weigert's elastic stain reveals marked hypertrophy of the elastic coat of the intima of the central artery. There is no evidence of new growth within or around the nerve.

Further progress of the case.—The skin flaps healed by first intention except for a small area in the depth of the orbit, which remained as a granulating surface on the bone until the end of November, 1921. By the end of November there was a granulating surface 2.0 mm. in diameter. The patient at this date appeared in good health.

In December, 1921, the blood was examined again, and in a differential white cell count showed only an increase of hyaline cells, as already mentioned.

Differential diagnosis

Clinical investigation, coupled with the pathological examination of the excised eyeball and of the recurrent mass in the orbit suggests various possibilities, of which some can quickly be abandoned.

1. *Granuloma or chronic inflammation.*—The history of syphilitic disease of the nose and the presence of a positive Wassermann reaction offered a possible explanation of the clinical condition. In the histological preparations a first glance at the scattered distribution of the cells within the anterior chamber supported the possibility of a chronic inflammation. However, the minute examination of the cells fails to reveal any that are typical of inflammation, acute or chronic, apart, perhaps, from some of the spindle-shaped cells.

2. *Lymphoma or lymphosarcoma.*—Cases of these conditions in which tumours of considerable size have developed in the subconjunctival tissue, and in which recurrence took place in the orbit after enucleation of the eyeball, have been described by Coats[1], and by Casolino[2]. In these, however, the primary tumour or tumours have displayed themselves in or near the typical lymph-bearing area, namely, at the fornix conjunctivae. Furthermore, in both the original growth and in the recurrences histological examination has always revealed a definite fibrous stroma. Thirdly, in lymphoma and lymphosarcoma the predominant cell has had some relationship in structure to a lymphocyte, whereas in the tumour under consideration the round cells are larger than cells of the lymph type and, particularly in the orbital recurrent mass, have a cell body of considerable size.

3. *Leucosarcoma.*—This group of tumours has a structure somewhat similar to the preceding, but is associated with a leucaemic condition of the blood[23]. In the case described, the blood showed no greater change than an excess of hyaline cells.

4. *Carcinoma.*—The general histological appearance in metastatic carcinoma of the choroid[17] is somewhat similar to that of the choroid in the case under consideration. The following points, however, weigh against the diagnosis of secondary carcinoma with extraocular extension:—(*a*) The growth, for inflammatory cause has been excluded, first made itself evident in an epibulbar position just above the limbus. At this time the vision of the affected eye was good, and according to the patient was only noticed to fail between 6 and 7 months later; (*b*) the extraocular mass of growth at this site was more extensive than at any part of the choroid; (*c*) the minute structure of the growth bears a much greater resemblance to a sarcoma than to a carcinoma. Also the histological appearance of the epibulbar mass bears no relationship to surface epithelium or glandular structure in the orbit. Hence the diagnosis of primary epibulbar or of metastatic choroidal carcinoma may be excluded.

5. *Endothelioma.*—Some of the cells in the epibulbar growth and in the orbital recurrence bear a slight resemblance to the so-called endothelial cell, but the majority of the nuclei stain much more deeply than endothelial cells, as shown in the coloured drawing of cells present in the orbital growth. In some parts of the sections made from the photoxylin block (Jordan's method), there is an appearance of the formation of spaces between the cells. Further, the very long spindle or rod-shaped nuclei seen in one small portion of the epibulbar growth, might conceivably be elongated endothelial cells cut on edge. The curved form of these nuclei and the presence of free red corpuscles between and among them is suggestive of a tendency on the part of the growth

cells to form spaces, and to perform a function of endothelial cells[28]. The criticism to be passed upon the first of these points is that there is also some space formation and separation of lamellae in the sclera in these paraffin-photoxylin sections, and that this space formation is not present in the celloidin sections. In the latter there is, however, the alveolar structure which is not uncommon in epibulbar sarcomatous growths[14]. To the second point it may be added that this crowded appearance of elongated nuclei is only seen in one small area, and to the third, that this area is particularly rich in capillaries and that the free red corpuscles may represent a small haemorrhage.

6. *Sarcoma.*—In the consideration of this arises again the question as to whether the growth is a primary epibulbar or a primary choroidal sarcoma. *In favour of a diagnosis of primary choroidal sarcoma* and against that of epibulbar may be adduced the following arguments:—

1. The inward extension of sarcoma from epibulbar growths is less common among recorded cases than the converse.

2. Lymph stream is probably the main cause of migration of sarcoma cells, according to Coats[25], and it is probable that the main lymph flow is outwards in the direction of the venous blood flow.

3. Flat sarcoma of choroid or ciliary body is not infrequently of long duration, up to several years, before any ocular symptoms are noticed[24]. In the case described, vision was known to be good for two months after the patient first noticed the extra-ocular swelling, and was not found by the patient to have failed before six or seven months had elapsed.

4. Pathological examination of flat sarcomata occasionally reveal very extensive spread of growth in the anterior part of the uvea without involvement of the posterior part, and so without interference with the actively visual part of the retina, and without obvious loss of visual acuity. An example of this is Parsons' case of ring sarcoma[27], a spindle-celled leucosarcoma involving the ciliary body and a large part of the iris, in an annular mass, but without extraocular extension.

On the other hand, in support of the diagnosis of primary epibulbar sarcoma there are the following facts:—

1. The first symptoms were referred by the patient to an epibulbar region.

2. The superior or original part of the epibulbar growth is more massive than any part of the choroidal growth.

3. The vision of the affected eye was definitely tested and found to be good, 6/6 with correction, two months after the recognition of the presence of the swelling, and was not noticed by the patient

to deteriorate until more than six months later. This fact, as already shown, is not of very great value.

4. The diffuse distribution of the growth through the choroid has more resemblance to a secondary growth in this situation than to a primary. In this connection may be cited a case of primary epibulbar sarcoma with invasion of the choroid, reported by Verhoeff and Loring[19], in which this point is emphasised. There is much resemblance between Verhoeff and Loring's case and the present case. It was shown conclusively that the former was primarily epibulbar. On the other hand, of 103 cases of primary sarcoma of the uveal tract, analysed by Lawford and Collins[5], in 21 cases extension outwards through the sclera occurred. All of these outwards extensions were localized except five. In these five cases the orbit was filled with a large mass of growth, or, as in one, there was a fungating mass. These outward spreading sarcomata, then, primary in the choroid, presented a very different picture from that of the cases above described. Among seven cases described by Kerschbaumer[12] as diffuse sarcoma of the eye there was none which had a distribution resembling this case.

5. Invasion of the deep scleral laminae by flat sarcoma of the choroid is common. In this specimen there is invasion of the outer layers but not to any extent of the inner sclerotic layers[14].

6. The growth in this case is well supplied with delicate capillaries, whereas in the usual flat sarcoma there is generally a lack of vessels, except in the rare angeio-sarcoma.

7. Flat sarcoma is usually deeply pigmented[24]. In the case described, there is no trace of pigmentation in the epibulbar or orbital growth, and only a few streaks of pigment in the choroidal portions, obviously remnants of the pre-existing choroid pigment.

In several other points the case resembles that of a typical epibulbar sarcoma. The age of the patient was 53 years at the time of his first visit to the hospital. The average age at which this type of growth appeared in Verhoeff and Loring's series of 73 cases collected from the literature in 1903, was 51 years, although it had occurred in some cases at the ages of 8, 11, and 14 years. Whereas, the average age of cases with sarcoma of the uveal tract as tabulated by Parsons[15], is 44.2 (Fuchs), 48.4 (Lawford and Collins), 48.7 (Pawel), in 259, 103 and 100 cases respectively. A history of trauma is not common, 6 in 73 cases[19] of epibulbar sarcoma. The site of origin of such tumours is usually at or near the limbus. The growth, as in this case, is relatively slow. The histological appearance is commonly that of rings or columns of cells in a somewhat alveolar formation[14, 16].

The cells are most often spindle-shaped, but may be round, and sometimes almost entirely large and multinucleated [20]. In sections of the case described, there are fairly frequent bi-nucleated

cells. Although, as a rule, sarcoma penetrates the cornea less frequently than carcinoma, and usually rides over the cornea, as here to some extent, yet actual penetration through Bowman's membrane does occur[6, 20].

Penetration of the eyeball (I) by epibulbar carcinoma

The following cases of epibulbar carcinoma with penetration of the eyeball have been described:—Heyder[9] reported an epibulbar carcinoma in a male of 55 years. In this, more than the anterior half of the globe was covered with growth, the cornea was perforated and the globe was partly collapsed. Reis' case[17], showed a large orbital tumour which surrounded the greater part of the posterior half of the globe, with a metastatic adeno-carcinoma which extended almost throughout the choroid. E. Treacher Collins[4] described a specimen sent by Dr. Maddox, in which the carcinoma had spread through the substantia propria at the limbus, and by the perivascular lymphatics of the anterior ciliary vessels, to the canal of Schlemm. Extension also took place backwards into Tenon's capsule, and thence over the sclera back almost as far as the entrance of the long ciliary arteries. The growth permeated along lymph channels part of the way through the sclera. Collins also referred to similar cases of spread to the canal of Schlemm, and thence to the interior of the eye, reported by Parisotti, Remak, Caspar, Lagrange, and Delord and Reval.

Extensive non-penetrating carcinomata have been described by Heyder[9], Meyer[13], Reis[17], and Lagrange[26]. The first was in a woman of 52 years, and the growth covered the whole of the cornea and more than the anterior half of the globe. The globe itself was intact and not perforated. Meyer's case of carcinoma and the epibulbar sarcoma described in this paper might well have been confused clinically. The former showed a pale red nodular mass up to three mm. in thickness which filled completely the outer half of the palpebral fissure and overlapped the cornea entirely except for a few millimetres on the nasal side. Reis described two cases of which one covered the greater part of the cornea and perforated Bowman's membrane in a small area, the second was referred to as a peribulbar epithelioma and overlay the front of the globe. Lagrange's case was one in which the whole of the globe was encircled by carcinomatous growth in a manner similar to the spread of the sarcoma above described, but the former did not penetrate the eyeball.

These cases of carcinoma do not pretend to exhaust the literature of the subject. They serve for comparison with epibulbar sarcoma. Inward spread of growth is commoner in carcinoma than in sarcoma[14].

Penetration of the eyeball (II) by epibulbar sarcoma

The only cases that were found in the literature with a resemblance to this case in their extension into the globe are those of—

1. Verhoeff and Loring[19].
2. v. Michel (quoted by the above from Bericht über Verhandlungen des IX Internat. Kongress, Utrecht, 1899).
3. Kerschbaumer[12].

The first of these has some clinical as well as pathological similarity with that which is under consideration, and from the aspect of diagnosis is worth quoting in some detail. The patient was a man, aged 40. Two years previous to his visit to hospital he had noticed a small red spot, the size of a pin head, above the cornea. One year later he was seen at hospital with a small round bluish swelling, which was thought to be a staphyloma. Finally, he was seen again, and on this occasion he had a rounded bluish swelling above the cornea, a smaller similar swelling below, and a third—the largest—12 mm. by 9 mm. by 6 mm. antero-posteriorly, projecting forward from the limbus on the nasal side. In this eye the ciliary body and part of the iris were replaced by growth, and the choroid contained a flat layer of growth extending as far back as the disc on the nasal side, upwards almost to the upper pole and downwards almost to the lower pole. The growth proved to be a spindle-celled moderately-pigmented sarcoma.

In the second case, that of v. Michel, the growth is quoted by Verhoeff and Loring as extending from the equator, above, forwards on to the upper part of the cornea. The iris and choroid were invaded throughout by growth cells. The patient is stated to have been a man aged 63 years, and to have noticed the swelling in the ciliary region first of all.

Kerschbaumer described a small round-celled sarcoma, with some larger polyhedral cells in its structure, and with haematogenous pigmentation. It was wide based, situated on the temporal side of the eye and over sclera and cornea. It penetrated to the canal of Schlemm, and thence through the ligamentum pectinatum to the ciliary body and root of the iris. The same author described two other epibulbar sarcomata with penetration of the globe, but in collapsed eyes.

Verhoeff and Loring quote Kolaczek* and Adamuck as having had each one case of epibulbar sarcoma with penetration of the globe. In the former the globe was found to be full of growth, in the latter there was a small penetration near the equator.

There are four other aspects of this subject that are of especial

* Quoted by Verhoeff and Loring from *Deutsch. Zeitschr. f. Chirurgie*, Bd. XII, 188, S. 75, and *Arch. f. Augenheilk.*, Bd. XI, S. 19, 1881.

interest. *The occurrence* of epibulbar sarcoma is, as is well known, extremely rare.

Crigler[6] reports the occurrence of only 4 among 100,000 cases of conjunctival affections.

Verhoeff and Loring[19] mention two in 44,719 eye cases, with 10 choroid sarcomata and 6 epibulbar carcinomata.

During the last two years, 1920, 1921, there has been one case of pigmented epibulbar tumour at the Central London Ophthalmic Hospital, out of a total of 26,152 eye cases. This tumour was classed by the writer as a melanotic sarcoma, although in one place its superficial cells were very closely associated with the conjunctival epithelium.

During the years 1920, 1921, there has been this one case of epibulbar sarcoma, which is of a particularly unusual type, at the Royal London Ophthalmic Hospital, and one case of epibulbar carcinoma. The latter case occurred in 1920, while Mr. M. H. Whiting was Curator. During this time nearly 100,000 separate patients attended.

The proportion of these epibulbar sarcomata to sarcoma of the eye as a whole is given by Kerschbaumer as 9 out of a total of 67 cases.

The origin of these growths is, naturally, rather speculative. There is evidence which is strongly suggestive that *epibulbar carcinomata* arise in some cases from *naevi*, pigmented as in v. Sicherer's case[18], or unpigmented. It is well known that *xerodermia pigmentosa* frequently terminates with carcinoma of the skin. Greeves reported a tumour on the globe of this origin[29].

As for epibulbar *sarcomata*, it is probable that some arise from *dermoids, dermo-lipomata* or from *melanomata*—referred to simple pigmented connective tissue tumours. A few have *trauma* as their actual or their exciting cause[14].

Malignancy and treatment.—There can be no doubt that the malignancy of epibulbar growths, be they carcinomata or sarcomata, varies to an enormous extent. At one extreme there is a case such as Wood's[22], in which there was a history of a swelling on the upper aspect of the globe, noticed 5 months prior to operation in a girl of 15 years of age. Already there was an enlarged pre-auricular gland. The child died 3 months after operation with abdominal symptoms suggestive of metastasis. At the other extreme is such a case as that reported on several occasions by Jessop[11]. The patient was a woman, Emily J. G., who suffered from the appearance of a localized melanotic sarcoma at or near the limbus at intervals of a few years. These tumours were excised locally, and the base was usually cauterized. In this way the patient was watched for 13 years.

Collins[30] referred to three cases of sarcoma, each of which was

treated by local excision of the growth. In the first, in which the pathological diagnosis was confirmed by Mr. Butlin, the patient was watched for 15 years without the appearance of any recurrence. The others were watched for 7 years, and several years respectively without reappearance of growth.

Collins[30] also reported a case of recurrent epibulbar sarcoma sent him by Mr. Cresswell, in which the rather wide-based growth was excised as far as possible and the base treated with three applications of radium. The vision of the affected eye was 6/6. The operation was in September, 1917, and in March, 1918, there was no sign of recurrence. A note received from Mr. Cresswell, January 11, 1922, stated, " I have not seen Annie W. for some time now, so conclude that she is keeping well."

Paton[3] referred to a patient with recurrent sarcoma which was excised locally, and stated that the patient was well 16 months later.

Storey[3] mentioned a case with extensive secondary growths and abdominal metastasis, which caused death within about two years of the date of operation.

Heckel[8] employed a very large number of doses of X-rays at short intervals, without excision, on a case of epibulbar sarcoma. The pathological report was made by Dr. Proescher. The patient was free from recurrence 5 years after his first visit.

Jean[10] removed a sarcoma locally, on account of blindness in the other eye, but the growth recurred. Wolfe[21] advocates immediate histological examination of the tumour at the time of local excision, and enucleation if the growth prove to be sarcoma. Verhoeff and Loring take a pessimistic view of every case of epibulbar sarcoma. Crigler quoted 12 cases from the literature. Of these 1 (Tweedy's) was fatal in 2 years. Five were watched and were free from recurrence respectively for 10 months, 1 year, 1 year, 1¼ years, 4 years.

The following results of operation on *epibulbar carcinoma* are of interest, in cases which have been followed up for considerable periods.

Meyer[13], local excision. Recurrence and further excision. No recurrence during 18 months.

Jessop[11], local excision. Watched for 22 years.

Collins[4]: (1) Radium treatment, one application only. The patient was well 5 months later, and died, according to recent information, without recurrence (date not known); (2) local removal. Pathological section by Coats. Well for 10 years without recurrence.

No hard and fast rule can be laid down for the treatment of either epibulbar carcinoma or sarcoma. Crigler's[7] three maxims should prove a useful guide:—

1. If the growth is freely movable with the conjunctiva over the underlying structures, with slow or imperceptible growth, remove locally.

2. If the least adherent, remove the globe and considerable margin of conjunctiva around. Apply radium.

3. If first seen with large growth, and history of rapid extension —exenterate the orbit.

I would venture to modify No. 2. If the growth is small—up to not more than a few millimetres in diameter of base—and yet is adherent, excise as freely as possible and apply radium. If the growth is large and the least adherent, enucleation should be performed.

(To be Continued.)

THE BOWMAN LIBRARY

BY

R. R. JAMES (Librarian)

LONDON

SWIFT is reputed to have said that a good library always made him melancholy, where the best author is as much squeezed and as obscure as a porter at a coronation. When I first took over the duties of Librarian, a year ago, I, like Swift, felt melancholy, not on account of the squeezing of our books, though our space of course is limited, but because of the many gaps in our sets of periodicals, which gaps it seemed almost impossible to fill up. When the Ophthalmological Society of the United Kingdom was founded in 1880, one of the main objects in the minds of the founders was the formation of an adequate ophthalmological library; Sir William Bowman presented the first bookcases, very solid and good light oak bookcases they are, and annually until his death gave a sum of money for the purchase of books; besides this his name figures on our balance-sheet in every year up to 1902 as the donor of a sum of money, usually £50, to the Society's funds. Every year from 1885 to 1913 a sum of money, usually either £20 or £40, was voted by the Council from the funds of the Society, for the upkeep of the library. Important gifts of books have been made from time to time by ophthalmic Surgeons, such as Mr. Nettleship, Mr. Jessop, Mr. Power and Sir Anderson Critchett, and the library has steadily grown, under the fostering hands of its former librarians, from small beginnings to be one of the finest collection of books on purely ophthalmological subjects in existence.

Mr. Adams Frost, who was Librarian from 1885 to 1905, deserves the thanks of all who are interested in ophthalmology; the catalogue is entirely his work, and no one can have much knowledge of the books in the library without realising what a vast amount of work he must have done to get together and keep together so fine a collection of volumes.

It is obvious that the main function of a library such as ours is to form a reference library, that what is most needful for us to have in it are sets of the well-known periodicals which deal with our subject, monographs and text books, new and old. Up to 1913, when the Library was made over to the Royal Society of Medicine, this function had been well supplied in each of the different branches, but since 1913 we have acquired very few of the modern text books, and naturally the disorganisation of the years 1914 to 1918 has made us very much behindhand with our foreign journals. Of minor interest are the antique books on ophthalmology such as those of Banister and Read. To take the more important branch of the library first, the periodicals: the English journals are complete, as might be expected. They are the *Royal London Ophthalmic Hospital Reports*, 20 volumes, beginning in 1857; the *Ophthalmic Review*, founded in 1881; the *Transactions of the Ophthalmological Society of the United Kingdom* dating from 1881; the *Ophthalmoscope* dating from 1903, and the *British Journal of Ophthalmology* dating from 1917. Besides these, a set of the Proceedings of the Ophthalmic Section of the Royal Society of Medicine has recently been made up and added to the library.

It is interesting to note that the library possesses the first two volumes of the old *Ophthalmic Review*; this quarterly journal of ophthalmic surgery and science was founded in 1865, edited by J. Zachariah Laurence, of London, and Thos. Windsor, of Manchester. After the year 1866 Laurence was alone in the editorship and the journal ceased to exist after Vol. 3 in 1867.

Of the German periodicals, *Archiv für Ophthalmologie* begins with the first volume published in 1854, and is complete to Vol. 79; after this, Vols. 82-87 and 91-93 and Vol. 101 are complete. Vols. 80, 81, 88, 89 and 90 lack about one part in each volume. At the present time I am trying to complete this most important set. The *Klinische Monatsblätter für Augenheilkunde* begins with Vol. 2, 1864; the volume for 1868 lacks its last three parts, October to December, the other numbers are present, clad in their paper covers of a dingy yellow colour; the volume for 1880 is absent, but thenceforward this journal is complete to 1920. Knapp's *Archiv für Augenheilkunde* is complete from 1869 to 1916. The *Jahresbericht der Ophthalmologie* is complete from Vol. 1, 1870, to 1912. The Bericht *Ophthalmologische der*

Gesellschaft in Heidelberg is complete from 1877 to 1920. The *Centralblatt für praktische Augenheilkunde* begins with Vol. 3, 1879, and is complete from that date to its final volume in 1919. The *Zeitschrift für Augenheilkunde* begins with Vol. 1, 1899, and is complete to Vol. 31, 1914.

The *Zeitschrift für physiologie der Sinnesorgane* begins with Vol. 1, 1890, and is complete to 1904. It is a great pity that this journal was not kept up, for it is rare to find so long a run of it in this country.

The *Archiv für vergleichende Ophthalmologie* begins with Vol. 1, 1909, and stops in the middle of Vol. 4, 1913. The *Zeitschrift für vergleichende Augenheilkunde* begins with Vol. 1, 1882, and runs for ten years to Vol. 7, 1892.

Of the French journals, the *Archives d'Ophtalmologie* begins with Vol. 4, 1884, and is complete thenceforward. The *Bulletin de la Société Française d'Ophtalmologie* is complete to date from its commencement in 1883. The *Revue Générale d'Ophtalmologie* is complete from Vol. 1, 1882 to 1913, and the missing parts from 1919 to date have been promised by the Editor. The *Recueil d'Ophtalmologie* is complete from Vol. 5, 3rd series, 1884 to 1911.

The *Archives d'Ophtalmologie* by M. A. Jamain is complete from Vol. 1, 1853 to Vol. 3, 1856. No more of it was published. The *Annales d'Oculistique* begins with Vol. 25, 1851, and runs to 1862; 1863 is missing, but it goes from 1864 to 1899 without a break. Volumes for 1900 and 1905 are missing, and thence onwards it is nearly complete. *La Clinique Ophtalmologique* begins with Vol. 1, 1895, and is complete to 1912.

Of the American journals, Knapp's *Archives of Ophthalmology* begins with Vol. 1, 1870, and is complete to Vol. 43; Vols. 46 and 50 are bound, but of the remaining volumes many parts are missing and are unobtainable. *The Annals of Ophthalmology* begin with Vol. 5, 1896, the volume for 1909 lacks one part, and so does the last volume, that for 1917. *Ophthalmic Literature* is complete, Vols. 1 to 7, 1911-1917. *The Ophthalmic Record* begins with Vol. 1, 1891; the 1899 volume is missing, and we have nothing after the volume for 1912. *Ophthalmology* is complete 1904, Vol. 1, to 1917, Vol. 13. The original *American Journal of Ophthalmology* is complete, save for a single part in each of the last two volumes.

These five American journals were incorporated in 1918 in the *American Journal of Ophthalmology*, of which not a single part has reached us, in spite of the fact that our volumes of Transactions have been sent regularly by our Publishers to the Editor in Chief of the American journal. We have the *Ophthalmic Yearbook* from Vol. 1, 1904, to Vol. 11, 1914. It will be remembered that

this publication now forms part of the *American Journal of Ophthalmology*. The *Transactions of the American Ophthalmological Society* begin in 1865, the volume of their Second Annual Meeting, and are complete to 1915. The volumes for 1919 and 1920 are present, and the remaining volumes will be sent to us in the near future. I may be allowed, in this place to record my grateful thanks to Dr. T. B. Holloway, the Secretary of the American Society, for the courteous way in which he has answered my numerous letters about our exchanges and for his kind assurance that our gaps in this periodical shall be supplied. " O si sic omnes."

The Journal of Ophthalmology, Otology and Laryngology begins with Vol. 1, 1889, and runs to Vol. 12; it is far from complete even for this short period.

Of the Italian journals, *La Clinica Oculistica* begins with Vol. 8, 1907, and runs in an incomplete manner to the volume for 1915. Of the *Annali di Ottalmologia* we possess a run from Vol. 36, 1907, to Vol. 44, 1915. The *Revista Italiana di Ottalmologia* we have complete save for one part, from 1905, its commencement, to 1914.

The only Spanish journal represented in our library is the *Archivos de Oftalmologia Hispano-Americanos;* with the exception of two parts it is complete from 1904 to date. We also have a short run of the *Anales de Oftalmologia* (*Uribe y Troncoso*) from Vol. 9, 1904 to 1911.

Besides these journals there are incomplete sets of a Dutch and a Russian ophthalmic journal, the title of the last of which forms such a " sea of consonants " that my pen is not able to embark upon it. The Danish journal of the Copenhagen Society is now in exchange with us, and we have an incomplete run from Vol. 1 to the present time.

The only other important periodicals to which I need refer are two in number. *Brain*, of which we have a complete set from Vol. 1 to Vol. 29, and the *Archives de Neurologie*, which begins with the first volume in 1880 and is complete to the year 1907, but before leaving the journals, it should be noted that the library possesses a copy of that rare work, *Annales d'Oculistique et de Gynaecologie*, by Cunier and Schoenfeld, Vol. 1, 1838-39, 24 parts, published at Charleroi. The combination of eyes and gynaecology eighty years ago must have fallen flat, for no more of this curious work was published. It is complete in one volume and is a scarce and valuable work.

I have devoted a good deal of space to the collection of the various journals, for they are the books which are of most value to the student of to-day, for the purposes of reference, but if any

are idly inclined they could spend an hour or two in examining the antiques of the Bowman Library with profit and amusement.

We have a fine copy of Bartisch's *Augendienst*, 1583; most of us would examine the wood cuts with interest, and would realise what a barbarous business excision of the eye must have been in the old days, before the present method was invented, which, after all, was not so very long ago; while lovers of ecclesiastical matters would be interested to see the cover in which it is bound, which has every appearance of having formed part of a missal or songbook, being, I fancy, the parchment page of a Church music book.

We have a fine collection of books on optics, among which the first in date is the fine folio, Zahn's "Oculus artificialis teledioptricus sive Telescopium," 1st edition, 1685, 2nd edition, 1702, copies of both of which are on our shelves. We have Molyneux's "Dioptricks," 1709; Sir Isaac Newton's "Opticks," 3rd edition, 1721; Benjamin Martin's "New and Compendious System of Optics," 1740, and Porterfield's "Treatise," 1759. Of these, I believe that Martin's work is distinctly scarce. To some will appeal the little duodecimo volumes. Richard Banister's "A Treatise on One Hundred and Thirteen Diseases of the Eyes and Eye-Liddes," 1622; Briggs's "Nova Visionis Theoria," 1685, and his "Ophthalmographia," 1686; and Guillemeau's "A Worthy Treatise on the Eyes," dedicated to his loving friend Mr. John Banester, chirurgion, 1622, translated by A.H. There seems to have been some virtue in the one hundred and thirteen in those days, for this little work deals with that number of diseases too. Another classic is Jehan Gottfried Zinn's "Descriptio Anatomica Oculi Humani," 1755; a second edition was edited by Wrisberg in 1780, and we possess copies of each edition.

Finally we can complete the list of curiosities with the volume of MSS, being the lectures on Diseases of the Eye given, in Paris probably, by Antoine Ferrien in 1740. It is a thick quarto volume beautifully written in an old French hand, indexed, and the cover, though now rather dilapidated, has been a good one in its day. Inspection of this work will remind us of a day when text books on our subject were practically non-existent, when the taking of notes at lectures was a fine art, and one indispensable to the student who desired to gain some knowledge of his subject, apart from the purely practical part of seeing the patients.

The Bowman Library, as all should know, now belongs to the Royal Society of Medicine. Those journals which exchange with the Transactions of the Ophthalmological Society will be kept fairly up to date, but apart from this, it is impossible to do much. We have no money to spare for the purchase of books, and it is

very questionable whether such works as Wilbrand and Saenger's "Neurologie des Augues," and Graefe Saemisch "Handbuch der gesammten Augenheilkunde," which were in course of publication in 1914, when the war broke out, will ever be completed on our shelves unless it be through the generosity of private members. The same applies to modern English textbooks. Is it too much to ask the authors of such works to be good enough to present a copy to the Library on the publication of their books? Of recent books I can only recall a copy of Foster Moore's "Medical Ophthalmology," which we owe to the generosity of Sir John MacAlister, and one of Lagrange's "Treatise on Glaucoma and Hypotony," which was kindly presented by Sir Anderson Critchett, who also very kindly gave us the memorial volume of Brisseau.

The collection of photographs of former Presidents of the Society is now complete.

I opened this paper with an extract from Swift's writings. Perhaps I may be allowed to close it with one from Charles Lamb's Essay on "Oxford in the Long Vacation": "What a place to be in is an old library. It seems as though all the souls of the writers that have bequeathed their labours to the Bodleian were reposing here as in some dormitory or middle state."

ANNOTATION

German Ophthalmological Literature since 1914

It has often been stated that science is independent of race, nation or creed. So far as it is truly science, it is universal. Prejudice, however well-founded in the political sphere, cannot blind us to the fact that Germany has in the past contributed in rich measure to the advancement of science, and ophthalmology in common with other branches of science owes much to her. Until the outbreak of war in 1914 German scientific publications were readily available to all students at reasonable prices. Some of these, such as the various Jahresberichts, were unsurpassed for completeness, accuracy, and general utility of reference. The characteristics of German mentality are peculiarly adapted to the painstaking sorting, abstracting, and arranging of large masses of literature. Nagel's *Jahresbericht für Ophthalmologie* was unique, unrivalled, and irreplaceable. Shortly before the War the *Zentralblatt für die gesamte Ophthalmologie und ihre Grenzgebiete* was started. It showed the same features of accuracy and utility as the *Jahresbericht*. It was not to be expected that these publications could withstand unmoved the shock of the War. Nagel's *Jahresbericht* eventually succumbed. In spite, however, of the

national disasters, apparently three volumes were published, and of the *Zentralblatt* six volumes. The *Jahresbericht* is now, in 1922, revived in somewhat different form, and includes the *Bibliographisches Jahresregister* of the *Zentralblatt*. These books, however, are attainable in England only with considerable difficulty and at outrageous cost, and the same remark applies to German ophthalmological books and journals, such as v. Graefe's *Archiv*. Though published at enhanced prices in Germany, they are, owing to the depreciation of the mark, extremely cheap in that country. For sale in foreign countries there is a tax of 50-200 per cent. on the published price, and the British agents seem to charge in addition an almost prohibitive commission. Now that peace has been restored it is preposterous that this state of affairs should continue. Science, both in England and in Germany, suffers, and solely in order that a few tradesmen may pocket an excessive unearned increment. In the long run it is bound to be bad for the tradesmen themselves. It is time that business relationships of this nature should return to the pre-war status. The published price in Germany should represent the value of the publication, and only reasonable additions should be made to cover the freightage. We earnestly commend these remarks to the notice of the German publishers of this type of literature and German scientists in general. Nothing will tend to restore amicable relations between the two countries more than a free interchange of literature; and above all, scientists, whether British or German, may at least agree that they are servants of science, in duty bound to advance science by every legitimate means.

ABSTRACTS

I.—PERMANENT DRAINAGE OF THE VITREOUS IN GLAUCOMA

Weekers, L. (Liège).—Permanent drainage of the vitreous in glaucoma. (Le drainage permanent du vitré dans la glaucome). *Arch. d'Ophthal.*, May, 1922.

The writer holds the opinion that direct decompression of the vitreous would be of great advantage in glaucoma. The excavation of the optic nerve, and the pressing forward of the lens and iris furnish evidence that the seat of the hypertonus is in the vitreous. The anterior chamber is shallow in glaucoma because the communication between it and the posterior chamber is more or less completely obstructed. Earlier researches have convinced the author that even in normal conditions the communication

between the two chambers is neither widely nor permanently open. The iris, applied accurately by its pupillary border to the lens, lies between the two chambers like a valve. The aqueous passing from the posterior to the anterior chamber raises this value, which opens and closes intermittently, as can be plainly demonstrated experimentally.

The communication between the chambers becomes more precarious when, as in glaucoma, the iris is sclerosed and rigid, and the hypertonus established in the vitreous pushes the lens forward and presses it against the iris.

The intra-ocular high tension thus restricts the passage of aqueous into the anterior chamber, the chief path of escape of intra-ocular fluids, and this in turn assists in the obliteration of the canal of Schlemm, the important outlet for the aqueous. As a result there is insufficient drainage of aqueous, leading to its retention and to an increase of intra-ocular tension. To remedy these conditions we may either establish a larger communication between the posterior and anterior chambers (as by iridectomy), or encourage the escape of aqueous from the anterior chamber (as in fistulising sclerectomy). Still another method would be to decompress directly the vitreous, and to allow drainage of intra-ocular fluids through the sclera.

Weekers has endeavoured to establish a permanent drain from the vitreous; the method he describes has been employed on rabbits' eyes and on a few human eyes blind from glaucoma and destined for excision for relief of pain. If the sclera be trephined the opening so produced quickly cicatrises and is completely obliterated. To counteract this, Weekers inserts a small gold ring of 2 mm. diameter with a grooved edge. The ring is cut from a small tube, with very thin walls, and is 1.5 mm. in height. The edges of the ring are everted at a right angle; the lower everted edge, which will be on the inner surface of the sclera, is narrower than the upper, which will be subconjunctival. By this procedure a direct and permanent drainage is established, as shown in rabbits by the following experiment:—A small quantity of 20 per cent. solution of fluorescine is injected into the vitreous at a point diametrically opposite the drain. In a few minutes the colour appears under the conjunctiva at the site of the drain, whereas it does not appear in the anterior chamber at the pupillary margin until more than an hour has elapsed.

Weekers operates thus:—The conjunctiva is dissected up in the upper temporal area, from a point near the limbus for a distance of about 7 mm. At this point the sclera is trephined with a 2 mm. trephine. In glaucomatous eyes an appreciable quantity of fluid escapes from the supra-choroidal space. Uveal tissue, recognizable by its colour, appears in the trephine aperture,

and may either be left intact, or picked up by forceps and cut off. By means of small forceps the gold drain is then inserted. By reason of the eversion of its lower lip, its diameter is greater than that of the aperture in the sclera, but the elasticity of the tissue allows of its easy introduction. Once in position the drain is firmly held and by reason of its everted edges cannot escape inwards or outwards. The conjunctival flap is carefully sutured with catgut.

Weeker's longest case is of 4 months' duration; the gold drain has been well tolerated and no reaction has followed.

After the operation intra-ocular tension has quickly been reduced to normal, and hypotonus has not been observed. Concomitantly with the reduction of tension, pain has been relieved and eyes have been retained which would otherwise have been enucleated. After the operation wound has healed the conjunctiva at the site of the gold drain shows a slight and persistent elevation, evidence of a permanent filtration of intra-ocular fluid into the subconjunctival tissue.

J. B. LAWFORD.

II.—PRIMARY SARCOMA OF THE IRIS

Fage (Amiens).—Primary Sarcoma of the Iris. (Sarcome primitif de l'Iris.) *Arch. d'Ophtal.*, Sept.-Oct., 1919.

Primary sarcoma of the iris is sufficiently rare to justify the reports of individual cases. Fuchs found only 16 examples in his 259 cases of sarcoma of the uveal tract, and Lawford and Collins had only one example in 103 cases. **Fage's** case was one of leuco-sarcoma, and of this variety Lagrange, in his work on " Tumours of the Eye " (1900), collected only 8 instances from ophthalmic literature.

Fage's patient, a woman 36 years of age, came under observation in May, 1917. For about 6 months she had noticed a flattened yellowish nodule near the base of the iris. There were no inflammatory signs, the tension was normal and the vision unaffected. The iris, which was grey-blue in colour, was covered in its lower third by a smooth slightly-raised growth, yellowish-brown in colour and devoid of visible blood vessels.

During the three months following, the tumour became appreciably larger, and in August had involved two-thirds of the iris in its lower temporal part. At this time the eye became suddenly glaucomatous and was excised on the 21st August. Eighteen months later the patient was in excellent health and the orbit was sound.

The tumour had its origin posteriorly near the attachment of the ciliary muscle, which was slightly displaced. Its anterior margin reached the pupillary edge, which was much thickened and pushed towards the centre of the pupil. Its posterior surface was covered by the uvea, which was stretched over it. The ciliary body was not invaded. The growth showed the histological characters of a sarcoma, with numerous vascular channels without definite walls. It did not contain any pigment except at a few spots near the posterior surface, where some pigment cells from the uvea had wandered into its substance. Compared with most reported cases of sarcoma of the iris the course of this tumour was unusually rapid.

J. B. LAWFORD.

III.—RETINITIS FOLLOWING ETHMOIDITIS

Gourfein-Welt, Madame (Geneva).—Retinitis following an Ethmoiditis. (Rétinite consécutive a une ethmoidite.) *Revue Générale d'Ophtalmologie*, September, 1921.

A rare and interesting case of retinitis, in a woman aged 40 years, unaccompanied by optic neuritis, following ethmoiditis and occurring during the course of the treatment of the latter, is reported by **Madame Gourfein-Welt**. The principal facts regarding the eye conditions (on the same side as the sinusitis) were: slight exophthalmos, central scotoma to 20 degrees, macula deep red standing out like a mushroom and surrounded by a brilliant pointed crown of radiating lines, white patch outside of the macula, inferior temporal vein greatly dilated and cloudy, small haemorrhages between the macula and this vein. Optic disc normal. Vision equal to fingers at one metre eccentrically. These facts, as observed by the author, were noted six weeks after the onset of the bad vision, which, in its turn, came on some days after a particularly painful nasal treatment which resulted in severe headaches and epistaxis. As the result of removal of polypi and cleansing of the ethmoidal sinus a rapid improvement in vision occurred so that V.A. ultimately became one-sixth. The central scotoma disappeared, but a nasal paracentral one, corresponding to the white patch, remained. At this time, $3\frac{1}{2}$ months after the first note, the macular changes had disappeared, whilst the white patch had increased and showed haemorrhages on its surface. The further course of this important case is not given, the author passing on to the consideration of certain questions arising from it. The first question is: "Is the retinal affection really due to the ethmoiditis?" The answer is in the affirmative, for reasons

given, which, being fairly obvious, need not be quoted. The second question concerns the method of propagation: (*a*) to the orbit; (*b*) to the retina without affecting the optic nerve. The author prefers the venous route to the orbit rather than the direct contact route, because the orbital symptoms were too moderate for suppuration to be inferred, and because the ethmoidal and orbital veins are in direct intercommunication. The route to the retina is more difficult. The author supposes that a "retrograde venous embolus" starting from a thrombo-phlebitis of an ethmoidal vein, found its way into a branch of the central retinal vein, and so to the macula.

The third question is: "What should be the conduct of the ophthalmologist when faced by a retinal affection which he believes due to an ethmoiditis?" The author replies in these words: "He ought not to advise intervention on the sinus, considering the danger to life of such intervention, unless the gravity of the retinal affection justifies it, and if the aetiological diagnosis has been exactly determined." Further study, she says, is desirable to make such aetiological diagnosis more certain than at present. Intervention having been decided upon, what is the method to be employed? The author follows Siegrist in considering that curettage of the sinus endonasally is dangerous, and that the sinus should be evacuated "by the surgical route." Gourfein-Welt concludes a well written article by hoping for free discussion at joint meetings of ophthalmological and rhinological societies of the treatment of the oculo-orbital complications of the various forms of sinusitis.

ERNEST THOMSON.

IV.—SUPERIOR QUADRANT HEMIANOPSIA

Gourfein-Welt and Redaillé (Geneva). — Superior quadrant hemianopsia: an anatomical and clinical study. (Hémianopsie en quadrant supérieure; étude anatomique et cliniqne.) *Revue Générale d'Ophtalmologie.* August, 1921.

Gourfein-Welt (Madame) and Redaillé report the case of a woman, aged 54 years, who presented a homonymous hemianopia of the right superior quadrant which did not involve the horizontal and vertical meridians or the fixation point. A right hemiplegia supervened, the patient died, and an examination of the brain was obtained. There were four foci of softening in the left hemisphere, all situated in the course of the posterior cerebral artery and its branches. The appearances of the vessels and chronic basal meningitis suggested syphilis as the cause. From their detailed

examination of the brain in this case the authors draw certain conclusions as to the course of the visual fibres. These conclusions will be given somewhat abbreviated: (1) That the superior quadrant hemianopsia is attributable to a lesion of the inferior lip of the calcarine fissure and constitutes one more proof in favour of the projection of the inferior quadrant of the retina on the inferior lip of the calcarine fissure; (2) that the persistence of vision in the horizontal and vertical meridians, in spite of the extensive lesion of the inferior lip of the calcarine, supports the theory according to which these two meridians receive a double innervation, namely, innervation by the two occipital lobes for the vertical and by the two lips of the calcarine fissure for the horizontal meridian; (3) that the integrity of the occipital pole in this case is in favour of the theory according to which the macula is projected to the posterior part of the calcarine fissure. This is contrary to the view of Henschen, who locates the macula in the anterior portion of the calcarine, and of Dejerine-Monakow who concluded for a cortical macular centre; (4) that (from details of the anatomical examination here omitted) the facts in this case are in favour of the theory according to which the visual fibres would be divided into two bundles, those which go to the superior lip of the calcarine fissure passing above the occipital cornu, those which go to the inferior lip passing below this cornu.

The article, which should be studied by those interested in cerebral localization, is illustrated by two charts of the visual fields and by one very rough drawing of the brain, showing the principal lesion. Regarding the charts, the reviewer has studied them carefully in relation to the text, and can but come to the conclusion that they do not actually bear out the statement of the authors that the vertical and horizontal meridians of the fields were unaffected, since, in one eye the superior vertical meridian is cut by the blind area at about 30 degrees, and in the other at about 20 degrees. Has the reviewer misunderstood the French? Here it is. "*L'examen du champ visuel révéla l'existence d'une hémianopsie homonyme en quadrant supérieure droit avec conservation de la vision maculaire et un champ visuel en excès dans les méridiens horizontal et vertical. Il existait en outre un rétrécissement concentrique du champ visuel.*" How is it possible to reconcile the words "*un champ visuel en excès dans les meridiens horizontal et vertical*" with the concentric contraction of the visual fields (which is actually shown on the charts)? The expression "*en excès*" must surely have some other meaning than that here given by the reviewer.

ERNEST THOMSON.

V.—THE HYPOTONIC ACTION OF MIOTICS IN GLAUCOMA

Köllner, H.—Observations upon the hypotonic action of miotics in glaucoma simplex. (Beobachtungen ueber die druckherabsetzende Wirkung der Miotica beim Glaukoma simplex.) *Zeitschr. f. Augenheilk.*, Band XLIII., Seite 381.

Köllner remarks that the problem as to how miotics reduce the tension of the eye is still unsolved in spite of numerous experiments and clinical observations. There are two theories which hold the field. One ascribes the action to contraction of the internal muscles of the eye, which either by smoothing out the iris folds, by contracting the ciliary muscle, or stretching the choroid, assist the outflow of fluid from the eye. The other view sees in the alteration of the calibre of the vessels the factor, which, by diminishing the blood flow and consequently the secretion of fluid, tends to lower the intra-ocular tension. It is possible that both factors may combine their action; and that hypotony is achieved by enlargement of the channels of egress and by diminished secretion. Wessely has shown by experiments that the initial rise of tension which follows the instillation of miotics is actually caused by an ephemeral dilatation of the blood vessels.

It is necessary first to rivet our attention upon the time relations of the dilatation of the pupil and the onset of hypotony. It has been stated that the onset of miosis may preced the fall of tension. Köllner agrees that this can happen, but he gives a number of curves showing the simultaneous contraction of the pupil and fall of tension. If the tension be taken within five minutes of the instillation it may be actually raised, because the drug, as stated above, first dilates the vessels.

If, however, we take the tension fifteen minutes after instillation the hypotony and miosis will march hand in hand. The effects pass off simultaneously after a period of from one to three days. This synchronism suggests that hypotony depends upon miosis. The effect of changes in the circulation can be investigated by the use of adrenalin. A woman of 57 suffering from glaucoma simplex was chosen for the experiment. The tension of each eye was over 70 Schiötz units. Adrenalin was injected under the conjunctiva of one eye and eserin instilled into the other. The pupil of the adrenalin eye dilated to the maximum, and after an hour or so the tension fell to 45. The tension of the eserin eye at once fell to 27. The experiment was repeated more than once, always with the same result. Eventually the adrenalin eye was treated with eserin and the tension fell to 27. The test showed that eserin works more quickly and intensively than adrenalin. If homatropin and eserin be instilled together the effect upon pupil and tension

is small. The pupil contracts slightly or not at all, and the fall of tension is minimal. This experiment tends to show that the hypotonic effect is not due to the vasoconstricting action of eserin, but upon its miotic action. In certain cases the initial vasodilator action of eserin and pilocarpin may cause acute glaucoma.

T. HARRISON BUTLER.

BOOK NOTICE

Dynamic skiametry and methods of testing accommodation and convergence. CH. SHEARD. Copyright 1920 by the Cleveland Press.

This monograph is essentially a plea for the greater use of dynamic testing in refraction work.

It is admirably written, and the explanations are greatly simplified by apt illustrations from the author's own records of actual cases.

By dynamic testing the author means the estimation by retinoscopy of the refraction of the eye under observation while in a state of accommodation. The procedure, as commonly adopted in this method, is first to obtain by static (ordinary) retinoscopy those refractive findings which put the eyes, monocularly, in an optical condition, such that the retina and the distant point, presumably passively fixed, are conjugate points. The distant corrections are then inserted before the eyes under test, and the patient is told to read aloud a series of letters indiscriminately arranged, or count a number of fairly large dots upon a test card attached to the retinoscope. At the same time examiner estimates the refraction with the mirror.

The first test described is that of dynamic skiametry, a method in which the author has obviously acquired great proficiency. He warmly advocates its general adoption, despite considerable skill required in its performance, because, *first,* it ensures greater accuracy in estimating refraction than does static skiametry; and, *second,* it affords valuable information regarding the amplitude of accommodation, and its co-ordination with convergence.

Duction and version tests, and those employed in the analysis of tonic, accommodative and fusion convergences are then described, and their significance in solving the "great ocular problem" of the "economic co-ordination of accommodation, and accommodative and fusion convergence," emphasized.

We cannot do better, in recommending the monograph to the profession, than quote the author's own hopes in publishing it, viz., that it will " stimulate thought, suggest new methods, and aid in the elucidation of some of the difficult problems of ocular refraction."

EUPHAN MAXWELL.

CORRESPONDENCE

WHAT IS AN "OPHTHALMOLOGIST"?

To the Editor of THE BRITISH JOURNAL OF OPHTHALMOLOGY

SIR,—Your account of the Oxford Ophthalmological Congress of July last includes a paragraph that recalls a friendly controversy for which THE OPHTHALMOSCOPE of October and November, 1915, courteously provided a platform. If I may judge from the terms of your report, your editorial judgment, I fear, is against the position I strove to maintain in the earlier correspondence. Nevertheless, I could wish, with your permission, to re-state this position.

The paragraph now in question announces that in an arranged discussion the subject was treated by one member " from the point of view of the physician," and by another " from that of the ophthalmologist." What may be the exact editorial definition of the term " ophthalmologist " I, of course, may not presume to say, but plainly in the above statement the " physician " is excluded from its contents. The two names are placed in contrast as though they were mutually exclusive. My submission, on the contrary, is that the terms have no common measure and cannot therefore rightly be set in opposition the one to the other.

" Physician," as a descriptive title, admittedly indicates that its bearer is engaged in medical practice as a duly qualified medical practitioner, and no one other than a qualified medical practitioner may legally adopt it. But " ophthalmologist " suffers no such restraint or protection, and clearly, therefore, cannot appropriately be used as descriptive of the professional activities of a member of the medical profession. If, then, the term " ophthalmologist " is neither a safe nor an accurate professional label it must be open to anyone who professes or cultivates an interest in ophthalmology, and the suggestion of exclusion implied in your paragraph cannot be justified.

Now and again through your columns we learn of the various activities of the " Council of British Ophthalmologists," and I note as relevant to the present issue that not all of those who

carry on the work of this organisation are engaged in surgical practice. Further, members of the Council, while appearing (quite rightly as I think) as " ophthalmologists " when occupied with their special corporate responsibilities, do individually, in the volume where each member of the profession has the opportunity to describe the fashion of practice he follows, name themselves " surgeons " or " ophthalmic surgeons." The difference thus displayed exactly illustrates my submission that " ophthalmologist " stands with anatomist, botanist, physiologist, and similar terms as an index, not of professional activities, but of personal studies and interests. It is not a monopoly of those of a particular group of medical practitioners, nor, indeed, of the medical profession generally.

I am, Sir, Yours,

C. O. HAWTHORNE.

HARLEY STREET, W.1.,
September 16, 1922.

To the Editor of THE BRITISH JOURNAL OF OPHTHALMOLOGY

SIR,—Your courtesy in showing us Dr. Hawthorne's letter affords us an opportunity of stating that the Council of British Ophthalmologists is composed solely of members of the Medical profession. From time to time, however, committees appointed by the Council have co-opted certain non-medical scientists, e.g., Sir Richard Tetley Glazebrook, and others, to give the Council the benefit of their advice in subjects in which their knowledge and experience are pre-eminent.

We are, Sir, Yours faithfully,

J. B. LAWFORD, President,
M. S. MAYOU, Hon. Secretary,
Council of British Ophthalmologists.

59, HARLEY STREET,
October 19, 1922.

DICHOTOMY

To the Editor of THE BRITISH JOURNAL OF OPHTHALMOLOGY

SIR,—I received, not long ago, a letter enclosing a typed communication from an optician who writes from Gray's Inn Road, canvassing for work. The final paragraph of this letter runs as follows:—" Should it be your custom to receive a commission on each patient sent me, then I would be pleased to make it pay for your trouble and work to mutual advantage."

Apart altogether from the very bad grammar in which this sentence is couched, it would be a serious breach of professional ethics for a surgeon to receive commission for any patient sent to an optician for glasses. We are sure that the great majority of "pukka" ophthalmic surgeons who are in practice in this country will agree with us in thinking that such a custom is most reprehensible. Either we are members of a profession or of a trade; if we are tradesmen, then there can be no objection to our following the routine practices of trade, but if we call ourselves professional men we should avoid doing so, and it seems to us that if it really is customary for any ophthalmic surgeons to work on these lines, they should take steps to have their names erased from the Medical Register, and so save the General Medical Council the trouble of doing it for them.

If "dichotomy is essentially dangerous, unsound and incompatible with professional dignity,"* among two members of the same profession, how much more is it, when it occurs between a professional surgeon and a shopkeeper!

At the present time there is nothing to stop any man who can afford the cost of a set of trial lenses, a set of test-types and a lamp from setting himself up as an ophthalmic surgeon; we cannot help thinking that this letter must have been meant for one of those whom we will call pseudo-ophthalmic surgeons.

Yours faithfully,

R. R. JAMES.

* Surbled's Medical Etiquette.

NOTES

Deaths

WE regret to report the death from heart disease of DR. GEORGE MILBRY GOULD, at Atlantic City, after an illness of three hours. He was born in Auburn, Mex., in 1848. He graduated from the Ohio Wesleyan University with the degree of Bachelor of Arts in 1873, and later completed a course of study at Harvard University. He received his medical degree in 1888, after which he practised ophthalmology in Philadelphia. Gould was widely known as a writer, and edited the *Medical News*, the *Philadelphia Medical Journal*, and *American Medicine*, and was a Member of the American Ophthalmological Society. He was well known in this country from his strong views as to the harmfulness of eye-strain, and opened an important discussion upon "Errors of Refraction" at the Oxford Ophthalmological Congress, July, 1917.

JUAN SANTOS FERNÂNDEZ, the doyen of Spanish American Ophthalmology, was born on July 22, 1847, in the province of Matanzas, at a spot now merged into the municipality of Alacranes. At 13 years of age he went to the Bilén College in Habana, where he obtained his degree of Bachelor, and later on entered the University of Habana. From thence he went to Spain and spent some time in the Medical School of San Carlos in Madrid. From 1872-1875 he was in Paris working in the Clinics of Galezowski, Desmarres, de Wecker, Panas, Abadie, and the elder Landolt. He returned to Cuba in 1875, and it was not long before he made his mark. He instituted reforms in the scientific circles of his native country, as the founder of the Laboratory of Histo-Bacteriology and Vaccination for rabies in 1887. It is 45 years since he founded the *Crónica Médico-Quirurgica*.

A bibliography of his published works brought out in 1917 showed them to be more than a thousand in number.

As the uncle of the editor of the *Revista Cubana de Oftalmologia* he naturally took great interest in and did much for this rising publication. All the numbers which have reached us have contained papers from his pen, mostly short papers on clinical subjects rather than abstruse disquisitions on conditions of theoretical interest. He died August 7, 1922, at his house, Prado 105, Habana, Cuba.

The deaths of two other American ophthalmic surgeons are also announced, namely, DR. JOSEPH L. DUNCAN, Jr., of Pittsburgh, and DR. FRANK W. MARTIN, of Lansing, Mich.

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Appointments

J. DUFF MCCULLOCH has been appointed Ophthalmic Surgeon to the Bradford Royal Eye and Ear Hospital.

F. L. THOMAS, honorary medical officer and ophthalmic surgeon to the North Devon Infirmary, has been elected mayor of Barnstaple.

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Errata

IN the article published by Dr. J. Lockhart Gibson on " Papilloedema " in the September number of this journal, the word drachms should be substituted for ounces wherever the latter occurs.